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# Research Aid

*Value Added by Work Brigades in Railroad  
and Highway Construction in China, 1952-57*

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*Value Added by Work Brigades in Railroad and Highway  
Construction in China, 1952-57*

November 1975

**VALUE ADDED BY WORK BRIGADES  
IN RAILROAD AND HIGHWAY CONSTRUCTION  
IN CHINA, 1952-57**

**SUMMARY**

1. Estimating the value added by work brigades in moving earth and stone<sup>1</sup> at railroad and highway construction sites in China during 1952-57 is no easy enterprise. From the welter of conflicting statistics in the Chinese press, estimates had to be made of the kilometrage and type of railroad and highway construction. Next, total earthwork had to be estimated, and then deflated by the share of the total performed by work brigades. Finally, the earthwork had to be costed using actual Chinese experience and engineering formulas.<sup>2</sup>

2. The earthwork performed on Chinese railroad and highway projects was small compared with total earthwork. Some 8.3 billion cubic meters (cu m) of earth were moved in construction projects during the First Five-Year Plan (1953-57).<sup>3</sup> Earthwork performed on rail and highway projects in this period amounted to 6%, a far cry from the 75% or so done in support of water conservancy.

3. The earthwork done in the transport sector, however, was significant because it permitted China to restore and build new lines of communications, thus consolidating political power and stimulating economic growth. This was done at minimal cost by efficient use of China's vast population.

**DISCUSSION**

**Earthwork in Railroad Construction**

*General*

4. When the Communists took power in 1949, they immediately began work on their railroad network of nearly 22,000 kilometers (km), half of which was

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1. Hereafter referred to as *earthwork*, that is, the movement (excavation and fill) of earth and stone in construction projects.

2. This publication used three Chinese engineering manuals to estimate earthwork requirements: 1955 *Chien-chu kung-ch'eng kai-suan chih-piao* (1955 Draft Standard Estimates for Constructional Engineering), National Construction Commission, Peking, translated in FDD 1543, 15 Nov 57 (for expansions of abbreviations used in the source references, see the Appendix); *T'ieh-lu kung-ch'eng lao-ts'ai shou-ts'e* (Railway Engineering Labor and Material Handbook), Peking, Oct 60, translated in JPRS 10217, 22 Sep 61; and *T'ieh-lu piao-chun she-chi yu-suan shou-ts'e* (Standard Railway Design and Budget Handbook), Ministry of Railways, Peking, 1960, translated in JPRS 10913, 31 Oct 61.

3. FBIS, 27 Sep 57, p. BBB 25.

in disrepair.<sup>4</sup> Tens of thousands of army engineers and civilians were organized by the state and began to extend the major east-west railway, the Lunghai, westward from Pao-chi. This railroad construction army grew rapidly and proliferated as the First Five-Year Plan generated fresh demands for new line construction throughout the country.<sup>5</sup>

5. These demands caused the railroad labor force engaged in construction to grow from about 500,000 in 1950 to more than 1.3 million at the end of 1956.<sup>6</sup> Less than 15% of this total constituted permanent cadres of the Ministry of Railroads and the Railroad Engineering Corps of the PLA who did the design, planning, and semiskilled and skilled tasks associated with railroad construction.<sup>7</sup>

6. These cadres supervised the hundreds of thousands of peasants and youths recruited for work on specific lines. China's success in new lines construction in 1952-57 can be largely ascribed to these laborers. Railroad construction in China was highly labor-intensive, requiring little skill: thus the unskilled masses could be recruited and used to good advantage in meeting rail completion targets. Recruitment was in two forms: (a) direct, in which farm laborers and youths were taken from farms and towns along the line (thus avoiding transport costs), and (b) indirect, in which laborers were first inducted into the PLA as noncombat troops and then dispatched to construction sites as Railroad Engineering Corps members. The laborers recruited directly were paid a basic wage in cash or kind based on a daily earthmoving norm and often had to supply their own tools.

### *Kilometrage Constructed*

7. To estimate the volume of earthwork performed by the Chinese in railroad construction in 1952-57, the kilometrage of various types of railroad projects constructed was determined. Table 1, which reflects official data and is consistent with a wide range of other sources, shows that a total of nearly 14,000 km of lines was completed during the period, 38% of it in new trunk line construction.

4. TGY, p. 144; *Ta-kung pao*, Hong Kong, 20 Nov 69, translated in JPRS 508824, 25 Jun 70.

5. SCMP 1698, 24 Jan 58, p. 17.

6. The railroad construction force - permanent, People's Liberation Army (PLA), and recruited peasants - in 1950 approximated that of the total railroad labor force (*North China Daily News*, Shanghai, 31 Jul 50, p. 2, and *Chung-kuo t'ieh-lu kung-jen* (China's Railroad Workers), Peking, 1 Dec 50, p. 12). The construction force in 1956 was estimated on the assumption that this relationship continued through that year (Ronald Hsia, *The Role of Labor-Intensive Investment Projects in China's Capital Formation*, Cambridge: MIT, 1954, p. 42, and *Kung-jen jih-pao* (Workers' Daily), 15 Feb 57).

7. Hsia, *op. cit.*

Table 1

Railroad Construction in China<sup>1</sup>

	Kilometers					
	Total	New Lines	Improved Lines	Double-Track Lines	Spur Lines	Forestry Lines
Total	13,916	5,341	1,079	1,465	2,906	3,125
1952	1,719	480	605	148	236	250
1953	1,500	587	....	119	494	300
1954	1,840	831	....	301	283	425
1955	2,464	1,222	39	145	458	600
1956	3,758	1,747	285	210	866	650
1957	2,635	474	150	542	569	900

## 1. Sources:

*New Improved, Double-Track, and Spur Lines.* TGY, p. 69. Spur lines, which are referred to as "special purpose lines," are reported but not included in the TGY total. Improvement is differentiated from maintenance by the type and amount of work involved on a particular line. This publication does not attempt to estimate the volume of earthwork required to maintain existing railroads.

*Forestry Lines.* By March 1955 the Chinese claimed to have more than 2,500 km of forestry lines (SCMP 999, 3 Mar 55, p. 20). TGY, p. 69, noted that 4,400 km were laid in 1950-58. The estimate assumes that there were about 1,000 km of forestry lines in 1949 and that construction of these lines increased as that of new trunk lines declined in 1957. Construction of forestry railroads is estimated to have totaled 200 km in 1950, 225 km in 1951, and 850 km in 1958.

*Volume of Earthwork*

8. An estimated 376 million cu m of earth had been moved in railroad construction projects in 1952-57. Of the total, 331 million cu m was moved in constructing new lines and the remainder in constructing improved, double-track, spur, and forestry lines (see Table 2). The coefficients used in making these estimates were as follows (in cu m per km)<sup>8</sup>:

New lines	61,900
Improved lines	12,400
Double-track lines	9,800
Spur lines	5,000
Forestry lines	1,000

*Contribution of Work Brigades*

9. Of the total earthwork moved in constructing railroads during 1952-57, an estimated 70% - 263 million cu m - was moved by work brigades, the remainder by permanent railroad construction cadres. The net value added by the work brigades in the six years totaled more than 147 million yuan (see Table 3).

8. For the methodology used in deriving these coefficients, see Table 2.

Table 2

Earthwork Performed in Railroad Construction in China<sup>1</sup>

Thousand Cubic Meters						
	Total	New Lines	Improved Lines	Double-Track Lines	Spur Lines	Forestry Lines
Total	376,000	330,608	13,380	14,357	14,530	3,125
1952	40,094	29,712	7,502	1,450	1,180	250
1953	40,271	36,335	....	1,166	2,470	300
1954	56,229	51,439	....	2,950	1,415	425
1955	80,437	75,642	484	1,421	2,290	600
1956	118,711	108,139	3,534	2,058	4,330	650
1957	40,258	29,341	1,860	5,312	2,845	900

## 1. Sources:

*New Lines.* The average volume of earthwork announced for eight major lines totaling 4,452 km was 51,900 cu m per km. Data used to derive this average are as follows:

Name of Line	Length	Earthwork (Thousand cu m per km)	Year Completed
(a) Ch'eng-tu to Chungking	505	59.4	1952
(b) T'ien-shui to Lan-chou	355	65.0	1952
(c) Pao-chi to Ch'eng-tu	670	89.7	1956
(d) Pao-t'ou to Pai-yun-o-po	150	37.7	1956
(e) Ying-t'an to Amoy	735	88.7	1956
(f) Lan-chou to Sinkiang (one section)	880	34.0	1958
(g) Nan-p'ing to Fu-chou	170	86.9	1958
(h) Pao-t'ou to Lan-chou	990	48.4	1958

The line lengths given in *TGY*, p. 70, were used although in some instances they are different from those in other official sources. Sources for individual lines were as follows: (a) *Economic Weekly*, Hong Kong, combined issue 290-291, 30 Sep 52, p. 16; (b) *Ching-chi nien-pao*, 1953 (Economic Yearbook, 1953), Hong Kong, 1953, p. 23-27; (c) *SCMP* 1331, 18 Jul 56, p. 16; (d) *JMJP*, Peking, 8 Dec 56; (e) *TKP*, Peking, 8 Dec 56; (f) NCNA, Lan-chou, 10 Dec 53, and *SCMP* 2122, 23 Oct 59, p. 15-16; (g) *SCMP* 1905, 2 Dec 58, p. 18; and (h) *SCMP* 1826, 6 Aug 58, p. 23.

*Improved Lines.* Improved lines were those which had fallen into disrepair and later been reconstructed, narrow-gauge lines which had been upgraded to standard gauge, and other lines on which permanent bridges and other facilities had been constructed to increase capacity. An earthwork average was derived by examining the repair work done on two lines during the period. The Chinese gave data on the repair of the 154-km Pao-chi to T'ien-shui and the 37-km Pao-t'ou to Shih-kuai-kou lines which averaged 12,987 cu m per km and 10,000 cu m per km, respectively. (*SCMP* 1408, 9 Nov 56, p. 15; BBC, pt. 5, No. 271, 20 Jun 57, p. 15; and FBIS, *Economic Item* 4582, Peking, 22 Feb 57). The weighted average of 12,400 cu m per km was used to estimate earthwork performed on all improved lines constructed during the period.

*Double-Track Lines.* No distinction was made between the volume of earthwork performed in new as opposed to restored double tracking, the amount required in the two types of construction not being significantly different. Double-tracking of the 173-km Sian to Pao-chi segment of the Lunghai railway completed in 1959 required an average of 9,769 cu m of earthwork per km (*SCMP* 1955, 17 Feb 59, p. 33). Rounded to 9,800 cu m per km, this average jibed with engineering requirements on the terrain on which double-tracking occurred in 1952-57 and thus was used to calculate the volume of earthwork for all double-tracking then.

*Spur and Forestry Lines.* There were no sources which reflected representative factors for earthwork movement in constructing spur and forestry trackage. Based on engineering requirements and a comparison with other types of railroad construction, therefore, these were estimated at 5,000 cu m per km and 1,000 cu m per km, respectively.

Table 3

**Earthwork Performed and Net Value Added by Work Brigades  
in Railroad Construction in China<sup>1</sup>**

	Earthwork Performed (Thousand Cubic Meters)	Net Value Added (Thousand Yuan)
<b>Total</b>	<b>263,201</b>	<b>147,392</b>
1952	28,066	15,717
1953	28,190	15,786
1954	39,360	22,042
1955	56,306	31,531
1956	83,098	46,535
1957	28,181	15,781

1. Sources.

*Earthwork Performed.* The work brigade share of total earthwork performed—70%—is derived from experience cited by the Chinese on the Ying-t'an to Amoy line (*SCMP* 1444, 5 Jan 57, p. 24). Analysis of the labor forces involved on various lines suggests that this percentage is probably representative for all lines. Thus this column simply reflects the earthwork performed in railroad construction in 1952-57, deflated by multiplying the volume by 0.70, which is the share of the total estimated to have been performed by work brigades.

*Net Value Added.* *FDD* 1543, p. 188, under "hard soil" gave 2 cu m per man-day (md) as the earthwork requirement for Grade 1 labor. Mechanization and excellent work organization, however, resulted in an average approaching 2.5 cu m per md for 1952-57. This norm was used on the pre-Five Year Plan Ch'eng-tu to Chungking line and a section of the Lan-chou to Sinkiang line (Ronald Hsia, *op. cit.*, p. 37; *SCMP* 1011, 19-21 Mar 55, p. 25). Thus 2.5 cu m per md is used to estimate total railroad earthwork during this period. Using this norm 40 md were required per 100 cu m of earthwork at a labor cost of 1.4 yuan per md, or 0.56 yuan per cu m (*FDD* 1543, p. 188).

## Earthwork in Highway Construction

### General

10. Chinese reporting on highway construction during 1952-57 was ambiguous and confusing. The Chinese distinguished between motor highways of six categories (depending on their traffic capacities), secondary highways, and simple roads (chien-i).<sup>9</sup> Among this plethora of categories, they further distinguished all-weather/unimproved, military/nonmilitary, and national/local highways. Moreover, though they reported extensively on highway developments through 1957, they often failed to differentiate between new construction and improvement.<sup>10</sup>

9. *FDD* 1480, 16 Sep 57, p. 31, and *FDD* 2185, 22 May 59, p. 27-28.

10. "Improvement" is construction to correct defects in existing roads or to upgrade roads so that they can accommodate more traffic. It is differentiated from maintenance by the type and amount of work involved on a particular road. This publication does not attempt to estimate the volume of earthwork required to maintain existing highways.

11. Given the plethora of road types and the terrain extremes in China, it is difficult to estimate the average volume of earthwork in new construction and improvement. The few published data on actual earthwork performed are unsatisfactory, thus requiring the use of Chinese engineering norms.

12. When the Communists took control of the mainland in 1949, about 75,000 km of roads was reported to be usable out of a total network of 130,000 km established under the Nationalists.<sup>11</sup> The highway system of China was a low-grade system by Western standards, characterized by a predominance of soil-aggregate and natural earth roads, low-capacity bridges, and numerous ferry crossings. Roads served primarily as feeders to railways and waterways or for short-haul traffic between cities.

13. Probably at least half of the 300,000 workers in highway operations in mid-1955 worked in the construction of new and improved highways.<sup>12</sup> Most of the peasants, youths, and PLA members involved in construction were not included in the total. Irrespective of the actual numbers, the bulk of the construction labor force consisted of unskilled peasants recruited locally in the slack farming season. In addition, members of the PLA constructed 13,900 km of highways in the decade 1949-58,<sup>13</sup> and militia and youth groups contributed significant amounts of labor for construction of the highway network.

#### *Kilometrage Constructed*

14. Construction during the first three years of Communist rule (1950-52) was largely done to restore existing highways. Because excavation had already been performed on these roads, which later fell into disrepair, relatively little new earthwork was required. In 1952, China built or improved a total of 11,168 km of highways, 83% being improvement construction. The First Five-Year Plan called for new construction and improvement of 25,100 km of motor and secondary highways by central and local organs.<sup>14</sup> By the end of 1957, 46,000 km had been achieved. Adding lower grade simple roads built in such profusion in 1956-57, more than 164,000 km of highways was newly constructed or improved in 1952-57 (see Table 4).

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11. JPRS 2537, 22 Apr 60, p. 1.

12. SCMP 1046, 12 May 56, p. 26.

13. FBIS, 25 Sep 59, p. BBB9.

14. JMCT, 31 Aug 55, p. 4-6.

Table 4

Highway Construction in China<sup>1</sup>

						Kilometers
	Total	New Highways			Improved Highways	Simple Roads
		Total	Motor	Secondary		
Total	164,009	21,369	10,164	11,205	36,088	106,552
1952	11,168	1,940	893	1,047	9,228	....
1953	9,654	2,598	1,196	1,402	7,056	....
1954	7,164	3,824	1,760	2,064	3,340	....
1955	8,138	3,579	1,647	1,932	4,559	....
1956	89,717	7,700	3,543	4,157	9,799	72,218
1957	38,168	1,728	1,125	603	2,106	34,334

## 1. Sources.

Total. *TGY*, p. 72.

## New:

## Total:

1952-55. *TGY*, p. 72.

1956. Estimated from the reported 1956 total of 17,499 km (*JMST*, 1958, p. 458) on the assumption that the ratio of new to improved highways constructed in 1956 was the same as in 1955.

1957. *JMJP*, 7 Mar 57.

Motor and Secondary. Estimated on the assumption that the ratio of motor to secondary highways in each year was the same as for the years 1953-56 as a whole. The total length of motor highways is the difference between the 1,125 km planned for 1957 and the 9,271 km for the First Five-Year Plan period (*FBIS*, 6 Mar 57, p. BBB19).

## Improved:

1952-55. The length of improved highways constructed is the difference between the total and the length of new highways.

1956. Estimated from the reported 1956 total of 17,499 km on the assumption that the ratio of new to improved highways constructed in 1956 was the same as in 1955.

1957. *JMJP*, 7 Mar 57.

Simple. The length of simple roads constructed is the difference between the total and the combined length of new and improved highways.

## Volume of Earthwork

15. During 1952-57, 233 million cu m of earthwork was done in constructing and improving highways. Broken down, 188 million cu m of this was in construction of new highways, 34 million cu m in improved highways, and 11 million cu m in simple roads. The coefficients used in deriving these estimates were as follows (in cu m per km)<sup>1 5</sup>:

New motor highways	13,000
New secondary highways	5,000
Improved highways	1,000
Simple roads	100

15. For the methodology used in deriving these coefficients, see Table 5.

Table 5

Earthwork Performed in Highway Construction in China<sup>1</sup>

Thousand Cubic Meters

	Total	New Highways		Improved Highways	Simple Roads
		Motor	Secondary		
Total	232,828	132,132	56,025	34,016	10,655
1952	24,000	11,609	5,235	7,156	....
1953	29,614	15,548	7,010	1,056	....
1954	36,540	22,880	10,320	3,340	....
1955	35,630	21,411	9,660	4,559	....
1956	83,865	46,059	20,785	9,799	7,222
1957	23,179	14,625	3,015	2,106	3,433

## 1. Sources.

1952. The Chinese announced that total earthwork in all highway construction in 1952 totaled 24 million cu m (*Ching-chi nien-pao*, 1953, p. 24). Multiplying the components of new construction by their earthwork coefficients (13,000 cu m per km of new motor and 5,000 cu m per km for new secondary highways) and summing yielded a total of 16,844,000 cu m of earthwork for new highway construction in 1952. Subtracting this from total highway earthwork of 24 million cu m that year left a residual of 7,156,000 cu m—or an average of 775 cu m per km—for the 9,228 km of improved highways. This is comparable to the average of earthwork for all roads in 1950 and 1951 or 517 cu m per km and 767 cu m per km, respectively (1950—8 million cu m per 15,463 km; 1951—15 million cu m per 19,545 km. See *TGY*, p. 72).

## 1953-57.

**New Highways.** For the new motor highways constructed, an earthwork coefficient of 13,000 cu m per km was used based on the 13,500 cu m per km derived for a road constructed in Shensi (*Peking Review*, 27 Dec 74, p. 21) and 12,971 cu m per km for the 2,255-km Sikang-Tibet highway in 1954 (*SCMP* 954, 23 Dec 54, p. 20: "Earthwork equals a canal 650 km long, 15 m wide, and 3 m deep." The 29.25 million cu m derived divided by the 2,255 km yielded 12,971 cu m per km). Secondary roads posed a greater problem. Although they were single-lane and cost much less than motor highways, they often required considerable earthwork, estimated here at an average of 5,000 cu m per km.

**Improved Highways.** This category embraced for the most part roads not requiring too much earthwork, and an average of 1,000 cu m per km was estimated for them.

**Simple Roads.** To increase agricultural output, China in 1956 launched a large-scale program of construction of simple roads. By the end of 1957, more than 100,000 km of such roads had been completed (*FBIS*, 16 Jul 1958, p. BBB 9-13). Built by peasants in the slack farming season, these roads were low-cost (190,000 km of simple roads constructed in Hunan in the first five months of 1958 averaged less than 50 yuan per km, according to *JPRS* 2537, 22 Apr 1960, p. 26) and in most cases involved merely the widening of cart trails, thus requiring little earthwork. An average of 100 cu m of earthwork per km is estimated to have been performed on these roads.

**Contribution of Work Brigades**

16. An estimated 85% of the earthwork performed in constructing highways in 1952-57 was done by work brigades paid in cash or kind. The total earthwork construction of work brigades in highway construction during the six years came to 198 million cu m. The net value added by this work totaled 101 million yuan (see Table 6).

Table 6

**Earthwork Performed and Net Value Added by Work Brigades  
in Highway Construction in China<sup>1</sup>**

	Earthwork Performed (Thousand Cubic Meters)	Net Value Added (Thousand Yuan)
<b>Total</b>	<b>197,904</b>	<b>100,931</b>
1952	20,400	10,404
1953	25,172	12,838
1954	31,059	15,840
1955	30,286	15,446
1956	71,285	36,335
1957	19,702	10,048

**1. Sources.**

*Earthwork Performed.* The share of the total earthwork performed by work brigades is estimated to be 85%. Compared with railways, highways involved shorter construction periods, less rigorous requirements, and fewer skilled cadres. For these reasons, the share of total earthwork performed by work brigades was greater in highway construction than in railroad construction.

*Net Value Added.* Average earthwork in highway construction in 1950-52 was reported as 2 cu m per md (*Ching-chi nien-pao*, 1953, p. 24). Thus, for 1952, 49.7 md were required per 100 cu m of earthwork (2 cu m per md at a wage of 50.7 yuan per 100 cu m, or a labor cost of 1 yuan per md, or 0.51 yuan per cu m). For 1953-57 a standard expenditure was estimated in md of 40 per 100 cu m of earthwork, or 2.5 cu m per md at a wage of 50.75 yuan per 100 cu m, or a labor cost of 1.28 yuan per md, or 0.51 yuan per cu m. (This estimate was derived from *FDD 1543*, p. 145, by taking a midpoint between "ordinary" and "hard soil" earthwork.) Although some reports reflected lower daily volumes, better construction practices probably led to output averaging 2.5 cu m per md during the period.

### Combining the Experiences: Total Work Brigade Contribution

17. Work brigades are estimated to have moved a total of 461 million cu m of earth in 1952-57 in railroad and highway construction,<sup>16</sup> contributing, in the process, a net value of 248 million yuan (see Table 7). Railroad construction claimed the major share of the effort: 57% of the earth moved and 59% of the net value added were performed in this sector.

16. A considerable achievement in six years. By contrast, only 425 million cu m of earth were moved in 25 years (1829-54) in the feverish building of nearly 30,000 km of railroads that expedited the industrial revolution in England (Samuel Smiles, *The Lives of George and Robert Stephenson*, 1874, reprinted by Folio Society, London, 1975, p. 13).

Table 7

**Total Earthwork Performed and Net Value Added by Work Brigades  
in Railroad and Highway Construction in China<sup>1</sup>**

	<b>Earthwork Performed (Thousand Cubic Meters)</b>	<b>Net Value Added (Thousand Yuan)</b>
<b>Total</b>	<b>461,105</b>	<b>248,323</b>
1952	48,466	26,121
1953	53,362	28,624
1954	70,419	37,882
1955	86,592	46,977
1956	154,383	82,890
1957	47,883	25,829

1. Source: Tables 3 and 6.

## APPENDIX

### ABBREVIATIONS FOR SOURCE REFERENCES

The following abbreviations are used in documenting source references:

- BBC* Great Britain, BBC, *Summary of World Broadcasts*
- FBIS* Foreign Broadcast Information Service, *Daily Report (Far East)*
- FDD* Foreign Documents Division, *Summary*
- JMCT* *Jen-min chiao-t'ung* (People's Communications), Peking
- JMJP* *Jen-min jih-pao* (People's Daily), Peking
- JMST* *Jen-min shou-ts'e* (People's Handbook), Peking
- JPRS* US Joint Publications Research Service
- NCNA* New China News Agency, Peking
- SCMP* US Consulate General, Hong Kong, *Survey of China Mainland Press*
- TGY* State Statistical Bureau, *Ten Great Years: Statistics of the Economic and Cultural Achievements of the People's Republic of China*, Foreign Language Press, Peking, 1960.
- TKP* *Ta-kung pao* (Impartial Daily), Peking